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# COST EFFECTIVE SMART VENTILATOR SYSTEM FOR COVID-19 PANDEMIC

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**ABSTRACT**: Electrical ventilation, or assisted ventilation, is the medical term for artificial ventilation where Electrical Motor is used to assist or replace spontaneous breathing. This may involve a machine called a ventilator, or the breathing may be assisted manually by an Electrical Motor by compressing a bag valve mask device. Logically, for the realization of any project, engineering and architectures must be governed by current regulations. However, we must ask whether the parameters required by regulations are sufficient or not. From this point, this is where intelligent ventilation comes into play. It makes no sense, from a logical and economic point of view, to practice the same levels of ventilation, for example, in a gym at night when it is completely empty than during the day when users use their services.

**KEYWORDS:-** Artificial ventilation Electrical ventilation, Electrical Motor, ventilator

## I. INTRODUCTION

According to healthcare specialists around the world, it is essential that the average person receives ample Sunlight and fresh air to breath. This gets difficult these days for people living in cities that are saturated and are often clustered in apartments or closely built houses. This is why old but effective use of ventilation systems comes in handy. Ventilation systems make use of the natural flow of the wind and create a consistent flow in buildings by which fresh air is supplied on a consistent basis. Traditional ventilation systems are now being upgraded by modern Heating, Ventilation, and Air Conditioning (HVAC) services.

HVAC Contractors based in Edmonton are perhaps some of the best ventilation service providers in the region. According to specialists today, ventilation systems are one of the most important features in the design of almost any type of construction. The advantages of ventilation, both in humans as well as in buildings, are undeniable and recognized through several studies. In addition, recent national and international rules require certain levels of ventilation obligatory, depending on the building and its application.

Electrical ventilation is indicated when the patient's spontaneous breathing is inadequate to maintain life. It is also indicated as prophylaxis for imminent collapse of other physiologic functions, or ineffective gas exchange in the lungs. Because Electrical ventilation serves only to provide assistance for breathing and does not cure a disease, the patient's underlying condition should be identified and treated in order to resolve over time. In addition, other factors must be taken into consideration because Electrical ventilation is not without its complications.

In general, Electrical ventilation is initiated to protect the airway/reduce work of breathing and/or correct blood gases.

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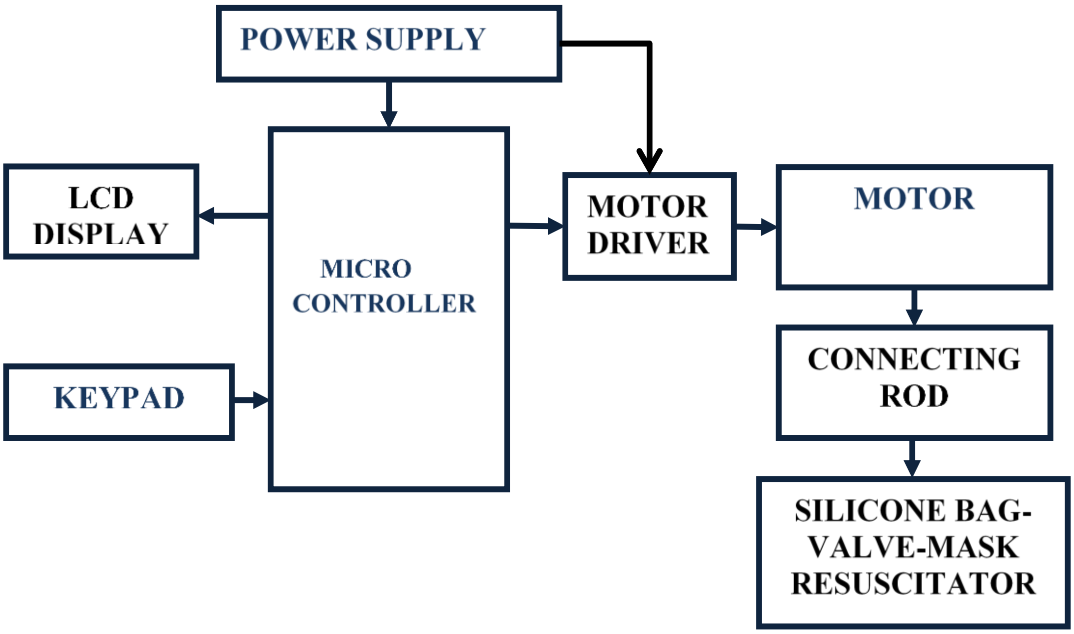
## II. LITERATURE SURVEY

2.1 Block Diagram

2.1Common specific medical indications for use include:
- Acute lung injury, including acute respiratory distress syndrome (ARDS) and trauma
- Apnea with respiratory arrest, including cases from intoxication
- Acute severe asthma requiring intubation
- Acute or chronic respiratory acidosis, most commonly with chronic obstructive pulmonary disease (COPD) and obesity hypoventilation syndrome
- Acute respiratory acidosis with partial pressure of carbon dioxide (Pco)
- 2) > 50 mmHg and pH < 7.25, which may be due to paralysis of the diaphragm due to Guillain–Barré syndrome, myasthenia gravis, motor neuron disease, spinal cord injury, or the effect of anaesthetics and muscle relaxants
- Increased work of breathing as evidenced by significant tachypnea, retractions, and other physical signs of respiratory distress
- Hypoxemia with arterial partial pressure of oxygen (PaO
- 2) < 55 mm Hg with supplemental fraction of inspired oxygen (FiO
- 2) = 1.0
- Hypotension including sepsis, shock, congestive heart failure
- Neurological diseases such as muscular dystrophy and amyotrophic lateral sclerosis (ALS)




**Figures 2.1 Block Diagram**

## III. VENTILATORS

3.1 Types of Ventilators

Ventilators come in many different styles and method of giving a breath to sustain life. There are manual ventilators such as bag valve masks and anesthesia bags that require the users to hold the ventilator to the face or to an artificial airway and maintain breaths with their hands. Mechanical ventilators are ventilators not requiring operator effort and are typically computer-controlled or pneumatic-controlled. Mechanical ventilators typically

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require power by a battery or a wall outlet (DC or AC) though some ventilators work on a pneumatic system not requiring power. There are a variety of technologies available for ventilation, falling into two main (and then lesser categories), the two being the older technology of negative-pressure mechanisms, and the more common positive-pressure types.


**Fig 3.1Ventilators**

3.2 Common positive-pressure mechanical ventilators include:

- Transport ventilators—These ventilators are small and more rugged, and can be powered pneumatically or via AC or DC power sources.
- Intensive-care ventilators—These ventilators are larger and usually run on AC power (though virtually all contain a battery to facilitate intra-facility transport and as a back-up in the event of a power failure). This style of ventilator often provides greater control of a wide variety of ventilation parameters (such as inspiratory rise time). Many ICU ventilators also incorporate graphics to provide visual feedback of each breath.
- Neonatal ventilators (Bubble CPAP[clarification needed])—Designed with the preterm neonate in mind, these are a specialized subset of ICU ventilators that are designed to deliver the smaller, more precise volumes and pressures required to ventilate these patients.
- Positive airway pressure ventilators (PAP) — These ventilators are specifically designed for non-invasive ventilation. This includes ventilators for use at home for treatment of chronic conditions such as sleep apnea or COPD.

3.3 Modes of mechanical ventilation

Mechanical ventilation utilizes several separate systems for ventilation referred to as the mode. Modes come in many different delivery concepts but all modes fall into one of three categories; volume-cycled, pressure-cycled, spontaneously cycled. In general, the selection of which mode of mechanical ventilation to use for a given patient is based on the familiarity of clinicians with modes and the equipment availability at a particular institution.

3.4 Positive pressure

Carl Gunnar Engstrom invented in 1950 one of the first intermittent positive pressure ventilator, which delivers air straight into the lungs using an endotracheal tube placed into the windpipe.

3.5 Neonatal mechanical ventilator

The design of the modern positive-pressure ventilators were based mainly on technical developments by the military during World War II to supply oxygen to fighter pilots in high altitude. Such ventilators replaced the iron lungs as safe endotracheal tubes with high-volume/low-pressure cuffs were developed. The popularity of positive-pressure ventilators rose during the polio epidemic in the 1950s in Scandinavia and the United States and was the beginning of modern ventilation therapy. Positive pressure through manual supply of 50% oxygen through a tracheostomy tube led to a reduced mortality rate among patients with polio and respiratory paralysis. However, because of the sheer amount of man-power required for such manual intervention, mechanical positive-pressure ventilators became increasingly popular.

Positive-pressure ventilators work by increasing the patient's airway pressure through an endotracheal or tracheostomy tube. The positive pressure allows air to flow into the airway until the ventilator breath is terminated. Then, the airway pressure drops to zero, and the elastic recoil of the chest wall and lungs push the tidal volume — the breath-out through passive exhalation.

**IV. PROPOSED METHODOLOGY**

4.1 Motor Drive

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. To simplify use as two bridges each pair of channels is equipped with an enable

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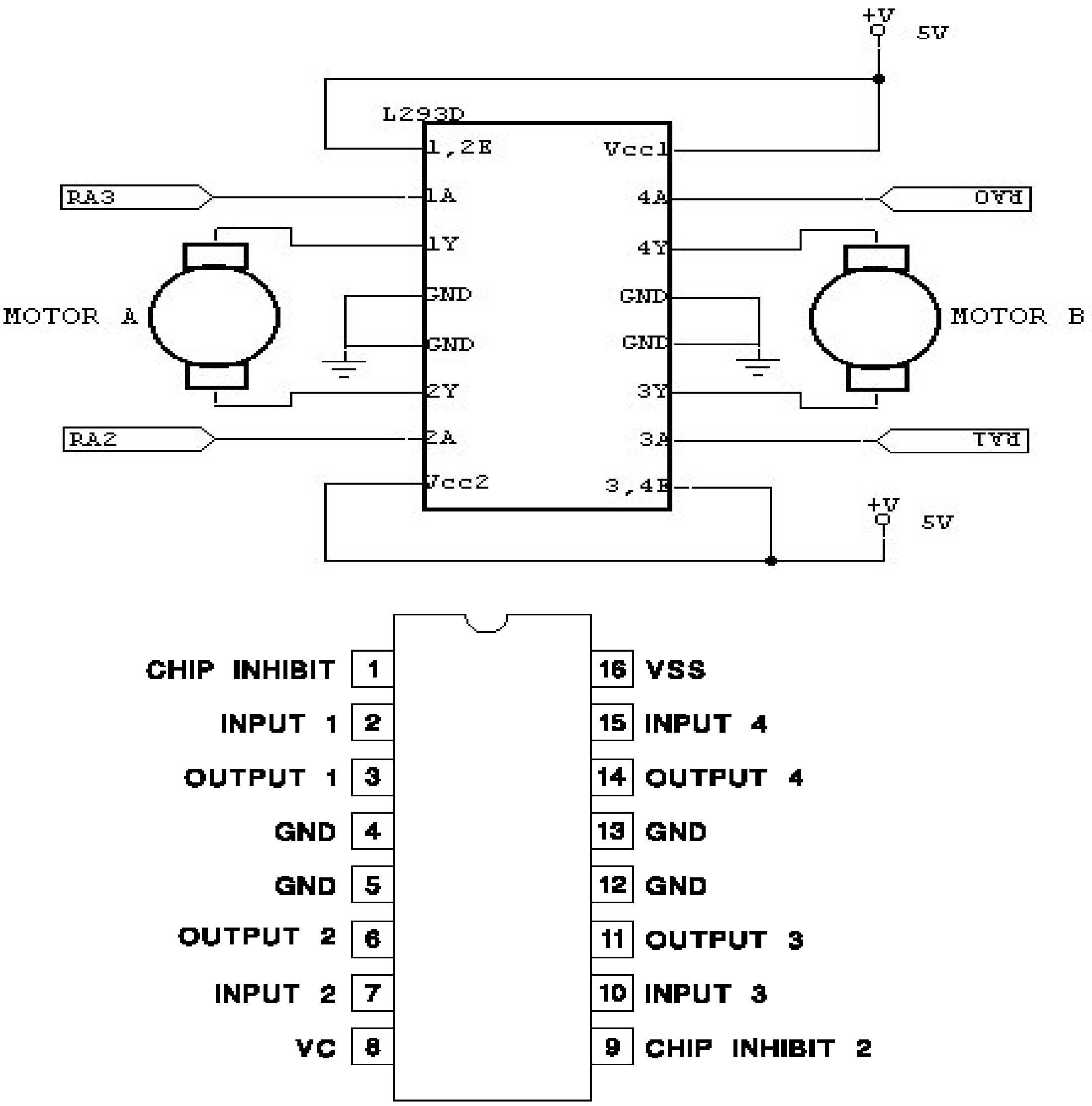
input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz. The L293D is assembled in a 16-lead plastic package which has 4 center pins connected together and used for heatsinking The L293DD is assembled in a 20-lead surface mount which has 8 center pins connected together and used for heatsinking.

4.2 L293D Motor Driver

The L293D is a quadruple push-pull 4 channel driver capable of delivering 600 mA (1.2 A peak surge) per channel. The L293D is ideal for controlling the forward/reverse/brake motions of small DC motors controlled by a microcontroller such as a PIC.

The L293D is a high voltage, high current four channel driver designed to accept standard TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. The L293D is suitable for use in switching applications at frequencies up to 5 KHz.




**Figures 4.2 L293D Motor Driver**

4.2.1 Features Include:

- 600 mA Output Current Capability Per Driver
- Pulsed Current 1.2 A / Driver
- Wide Supply Voltage Range: 4.5 V to 36 V

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- Separate Input-Logic Supply
- NE Package Designed for Heat Sinking
- Thermal Shutdown & Internal ESD Protection
- High-Noise-Immunity Inputs

4.3 Servomechanism

A servomechanism, or servo, is an automatic device that uses error-sensing negative feedback to correct the performance of a mechanism. The term correctly applies only to systems where the feedback or error-correction signals help control mechanical position or other parameters. For example, an automotive power window control is not a servomechanism, as there is no automatic feedback that controls position—the operator does this by observation. By contrast the car's cruise control uses closed loop feedback, which classifies it as a servomechanism.

A servomechanism may or may not use a servomotor. For example, a household furnace controlled by a thermostat is a servomechanism, yet there is no motor being controlled directly by the servomechanism.

A common type of servo provides position control. Servos are commonly electrical or partially electronic in nature, using an electric motor as the primary means of creating mechanical force. Other types of servos use hydraulics, pneumatics, or magnetic principles. Servos operate on the principle of negative feedback, where the control input is compared to the actual position of the mechanical system as measured by some sort of transducer at the output. Any difference between the actual and wanted values (an "error signal") is amplified and used to drive the system in the direction necessary to reduce or eliminate the error. This procedure is one widely used application of control theory.

Speed control via a governor is another type of servomechanism. The steam engine uses mechanical governors; another early application was to govern the speed of water wheels. Prior to World War II the constant speed propeller was developed to control engine speed for maneuvering aircraft. Fuel controls for gas turbine engines employ either hydromechanical or electronic governing.
Positioning servomechanisms were first used in military fire-control and marine navigation equipment. Today servomechanisms are used in automatic machine tools, satellite-tracking antennas, remote control airplanes, automatic navigation systems on boats and planes, and antiaircraft-gun control systems. Other examples are fly-by-wire systems in aircraft which use servos to actuate the aircraft's control surfaces, and radio-controlled models which use RC servos for the same purpose. Many autofocus cameras also use a servomechanism to accurately move the lens, and thus adjust the focus. A modern hard disk drive has a magnetic servo system with sub-micrometer positioning accuracy.

## V. EMBEDDED SYSTEM

5.1 Embedded System

An embedded system is a combination of computer hardware, software and additional mechanical parts, designed to perform a specific function. An embedded system is designed to do a specific task within a given time frame, repeatedly, without human interaction. Embedded system does not need a complete operating system, but only the basic functionalities of an operating system in a real-time environment, that is, a real time operating system. (RTOS). Frequently, embedded system does not have a user interface.

Application Area of embedded system include aerospace/defense systems, telecommunication equipment’s and switches, mobile computing, broadcast, automotive, industrial process control and monitoring, medical electronics, consumer electronics, etc. Main hardware components of an embedded system are microprocessor or micro controller, and supporting ICs.

The combination of micro-controller and ICs are application specific. Commonly used microprocessors include the following. Motorola 680XX series, IBM PowerPC series processors, MIPS processors, Intel 386 and compatible CPUs, ARM processors, Sun SPARC series, etc. Embedded systems need memory for storing programs and data, and usually programs are stored in ROM or EPROM. Often these systems have a serial port network interface, I/O interface for interacting with sensors and actuators in the case of process controlling systems.

5.2 ADVANTAGES IN USINGPIC

- Microchip is the world’s first largest chipManufacturer.
- Focus on high performance cost-effective, field-programmable embedded controlSolutions.
- Microchip is the first Manufacturer of 8 pin RISCMCU.
- Variety of end-user Application-specific Standard Products (ASSP) & Application-Specific Integrated Circuits(ASIC).
- Global network of manufacturing and customer supportfacilities.
- Non-Volatilememory.

## VI. CONCLUSION

Intelligent ventilation allows regulating fans and even heat distribution, depending on the parameter that the designer deems appropriate for specific areas. This parameter is read by a probe or sensor, which transforms the parameter itself into a digital or electrical signal, so that it can be read by a regulatory element that will tell the fan how to operate, while increasing the speed, reducing it or even turning it off.

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